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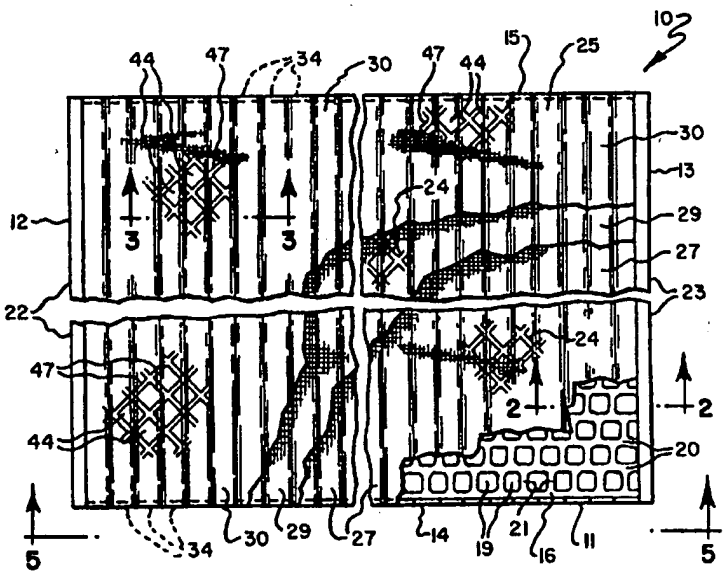
(54) Title: UNDULATING SCREEN FOR VIBRATORY SCREENING MACHINE AND METHOD OF FABRICATION THEREOF



(57) Abstract

A screening screen assembly (10) for a vibratory screening machine (35) including an apertured plate (11), and a bonded subassembly (25) of an undulating support screen (27) and fine screening screen (29) and finer screening screen (30) bonded to each other by a fused plastic grid (24) and bonded to the apertured plate. A method of fabricating a screening screen assembly for a vibratory screening machine including the steps of providing a support screen (27), superimposing a plastic grid (24) onto the support screen, superimposing a fine screening screen (29) onto the plastic grid (24), superimposing a finer screening screen (30) onto the fine screening screen, applying heat and pressure to the superimposed screens to fuse the plastic grid and thereby form a flat bonded laminate subassembly by causing the fused plastic grid to permeate the fine screen and the finer screen and the support screen, forming the bonded laminate subassembly into an undulating shape, providing an apertured plate (11), and bonding the undulating bonded subassembly to the apertured plate.

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UNDULATING SCREEN FOR VIBRATORY SCREENING MACHINE AND METHOD OF FABRICATION THEREOF

BACKGROUND OF THE INVENTION

The present invention relates to an improved vibratory screen assembly for a vibratory screening machine and to an improved method of fabrication thereof.

In copending patent application Serial No. 08/062,464 filed May 14, 1993, a vibratory screen assembly is disclosed having an undulating screen subassembly bonded to a perforated plate. The vibratory screen assembly of the present invention is an improvement over the prior assembly.

SUMMARY OF THE INVENTION

It is one object of the present invention to provide an improved vibratory screen assembly wherein an undulating screen, which is bonded to a perforated plate, is constructed in such a manner that a plurality of the screens which are bonded to each other in an undulating shape can yield slightly relative to each other during operation at high gravity forces, to thereby not only prolong their longevity but also tend to obviate blinding.

Another object of the present invention is to provide an improved screen for a vibratory screening machine which can be fabricated in a relatively simple and efficient manner.

Yet another object of the present invention is to provide an improved screen assembly for a vibratory screening machine in which a plurality of screens are bonded to each other in a very secure manner so as to tend to obviate separation thereof when subjected to high G forces in operation.

A further object of the present invention is to provide an improved method for fabricating an undulating vibratory screen assembly for a vibratory screening machine. Other objects and attendant advantages of the present invention will readily be perceived hereafter.

The present invention relates to a screening screen assembly for a vibratory screening machine comprising an apertured plate, a bonded undulating subassembly of a support screen and a fine screening screen bonded to each other by a fused plastic grid, and means bonding said bonded undulating subassembly to said apertured plate.

The present invention also relates to a method of fabricating a screening screen assembly for a vibratory screening machine comprising the steps of providing a support screen, superimposing a plastic grid onto said support screen, superimposing a fine screening screen onto said plastic grid, fusing said plastic grid into said superimposed support screen and fine screen to form a bonded subassembly, forming said bonded subassembly into an undulating screen configuration, providing an apertured plate, and bonding said undulating screen configuration to said apertured plate.

The various aspects of the present invention will be more fully understood when the following portions of the specification are read in conjunction with the accompanying drawings wherein:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a fragmentary plan view of one embodiment of the improved screen assembly of the present invention with portions broken away to show various layers thereof;

FIG. 2 is a fragmentary enlarged cross sectional view taken substantially along line 2-2 of FIG. 1 and showing primarily the construction at the ends of the screen supporting plate for securing the vibratory screen in a vibratory screening machine;

FIG. 3 is a fragmentary cross sectional view taken substantially along line 3-3 of FIG. 1;

FIG. 4 is a cross sectional view taken substantially along line 4-4 of FIG. 3;

FIG. 5 is a fragmentary end elevational view taken substantially in the direction of arrows 5-5 of

FIG. 1 and showing, in addition to the screen, portions of a vibratory screen machine which may support the screen assembly;

FIG. 6 is an exploded perspective view showing the components of one embodiment of the screening portion of the screen assembly prior to being bonded together;

FIG. 7 is a fragmentary plan view of the preferred pattern of the perforated plastic grid which is used to bond the screens of the screen assembly together;

FIG. 8 is a schematic view showing the step of bonding the screens together by the use of the perforated plastic grid;

FIG. 8A is a fragmentary end elevational view of the screen laminate after the individual screens have been bonded together;

FIG. 9 is a schematic view of the first step in the forming of the bonded screens into an undulating shape;

FIG. 9A is a schematic view of the second step in forming the bonded screens into an undulating shape;

FIG. 9B is a fragmentary diagrammatic view of the undulating screen immediately after it has been formed;

FIG. 9C is a fragmentary diagrammatic view of the undulating screen after its ends have been flattened;

FIG. 9D is a fragmentary diagrammatic view of the undulating screen of FIG. 9C being aligned with the perforated plate to which it is to be bonded;

FIG. 10 is a reduced diagrammatic end elevational view showing the undulating screen being bonded to the perforated plate;

FIG. 11 is a fragmentary perspective view showing the process of sealing the open ends of the ridges of the undulating screen;

FIG. 12 is a fragmentary end elevational view showing the sealed ends of the ridges;

FIG. 13 is a fragmentary cross sectional view showing the seals in the ends of the ridges;

FIG. 14 is a fragmentary plan view of an alternate pattern of a perforated plastic grid which can be used to bond the screens;

FIG. 15 is a fragmentary plan view of another pattern of a plastic grid which can be used for bonding the screens;

FIG. 16 is a fragmentary plan view of still another pattern of a plastic grid which can be used to bond the screens;

FIG. 17 is a fragmentary plan view of still another pattern of a plastic grid which can be used to bond the screens;

FIG. 18 is a fragmentary plan view of still another pattern of a plastic grid which can be used to bond the screens;

FIG. 19 is a fragmentary cross sectional view similar to FIG. 3 but showing another embodiment of the present invention; and

FIG. 20 is a fragmentary plan view of a plurality of undulating screen assemblies aligned on the bed of a vibratory screening machine.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

One embodiment of the improved screen assembly 10 is shown in FIGS. 1-5, and its method of fabrication is shown in FIGS. 6-13, and alternate configurations of a plastic grid which can be used in the process of fabricating the screen are shown in FIGS. 14-18, and an alternate embodiment of the present invention is shown in FIG. 19.

The improved screen assembly 10 of FIGS. 1-5 includes a frame in the form of a perforated metal plate 11, such as steel or any other suitable metal, having a first pair of opposite edges 12 and 13 and a second pair of opposite edges 14 and 15 and an upper surface 16 and a lower surface 17. Plate 11 includes apertures 19 which are bordered by elongated metal strip-like portions or members 20 which extend between edges 12 and 13 and by shorter

strip-like portions 21 which extend lengthwise between elongated strip-like portions 20. The openings 19 are formed by a punching operation and are quadrangles of approximately 1 inch square with rounded corners but they may be of any other desired shape or size. Strip-like portions 20 and 21 are approximately 1/10 of an inch wide, but they may be of any desired width. The length of plate 11 between edges 12 and 13 may be approximately 3 1/2 feet and its width between edges 14 and 15 may be approximately 2 1/2 feet, and it may have a thickness of about 1/16 of an inch. However, it will be appreciated that the size of plate 11 may vary as required to fit different machines. The width of each opening 19 is a small fraction of the length of the plate between edges 12 and 13. The same is true of the relationship between the height of openings 19 and the width of the plate between edges 14 and 15. Channel-shaped members 22 and 23 are mirror image counterparts and are constructed as shown in FIG. 2. More specifically, an extension 18 of plate 11 is folded into a channel-shaped configuration and a member 26 is bent to the shape shown in FIG. 2 from a single piece of metal and it brackets the edge 13 in the manner depicted in FIG. 2 and it is welded thereto. Channel-shaped member 22 is of the same construction. The foregoing description of plate 11 is essentially set forth in U.S. Patent No. 4,575,421. As will be apparent hereafter, any suitable plate or any suitable frame which provides the frame portions or members to which a frame can be attached may be utilized. Such alternate configurations are described in copending application Serial No. 08/062,464, filed May 14, 1993, which is a continuation-in-part of application Serial No. 08/004,122, filed January 13, 1993.

The main feature of the embodiment of FIGS. 1-5 is that the plurality of screens which are secured to plate 11 are bonded together into a subassembly by a perforated plastic grid 24 which has been fused into the screens by suitable heat and pressure. Thus, the screen subassembly

25 includes a coarse screen 27 which serves a supporting function and may have a size of between 6 mesh and 20 mesh or any other suitable size. A fine screening screen 29 is bonded to coarse supporting screen 27 and it may have a mesh size of between 30 mesh and 325 mesh, or any other suitable size. A finer screening screen 30 is bonded to fine screening screen 29 and it may have a mesh size of between 40 mesh and 400 mesh, or any other suitable size. Preferably the intermediate fine screen 29 should be two U.S. sieve sizes coarser than the finer uppermost screen 30. The three screens 27, 29 and 30 are bonded to each other by a fused plastic grid 24 which permeates all three screens. The screen subassembly 25 is formed in undulating curved shape, as depicted in FIG. 3, and it has ridges 31 and troughs 32. The undersides of troughs 32 at 33 are bonded to plate 11 by a suitable adhesive such as epoxy. This bonding at 33 occurs at all areas where the undersides of the troughs 32 contact strips 20 and 21, as depicted in FIG. 4. The open ends of the ridges 31 are sealed or blocked by polyurethane caps 34 which are molded into place in a manner which will be described hereafter relative to FIGS. 11-13.

The screen assembly 10 can be mounted in a vibrating screening machine 35 by means of elongated channel-shaped drawbars 37 and 39 which engage channels 22 and 23, respectively, and are drawn up by means of nut and bolt assemblies 40 and 41, respectively, as is well known in the art. Screen assembly 10 rests on a well known type of frame (not fully shown) having a plurality of elongated members 42 and 43 extending parallel to channels 22 and 23. In its operative position, screen assembly 10 is bowed slightly so that its center along a line parallel to edges 12 and 13 is higher than the outer edges 12 and 13, as is well known. However, the screen assembly 10 can be mounted in any other manner by any other type of mounting arrangement depending on the machine in which it is used. The channels 37, 39 and draw bolts 40, 41 do not form any part

of the present invention and are merely disclosed as being representative of one type of mounting, and it will be appreciated that other mounting structures known in the art may be utilized.

The screen subassembly 25 consisting of bonded screens 27, 29 and 30 is formed in the following manner, as schematically depicted in FIGS. 8, 8A, 9 and 9A-9D. The screens 27, 29 and 30 and the plastic grid 24 are superimposed in contiguous abutting relationship in the order shown in FIG. 6, and suitable heat and pressure are applied to bond the foregoing parts into a unitary configuration wherein the plastic grid 24 fuses in a precisely controlled pattern and permeates the three screens 27, 29 and 30 and bonds them together, as can be seen from FIG. 1. The fact that the grid 24 fuses in a precisely controlled pattern obviates the difficult requirement of precisely controlling the amount of adhesive which is applied. In this respect, if the screens are bonded with too much adhesive, such as epoxy, their open area is reduced, and if they are bonded with too little, they will not be attached to each other with sufficient strength. Furthermore, the use of a plastic grid enhances the ease of production.

The plastic grid 24 provides a gridwork within the screen assembly 25 wherein there are openings 44 (FIG. 1) between the plastic portions of the grid 24. A fragmentary plan view of the plastic grid is shown in FIG. 7 and it includes a border 45 and grid border portions 47 which outline openings 44. The plastic grid 24 is preferably made of polyethylene, and in this instance it was approximately .062 inches thick in the form shown in FIG. 6, that is, before it was fused by heat and pressure into bonding relationship with screens 27, 29 and 30. The bonding was effected by pressing the superimposed abutting screens 27, 29 and 30 and plastic grid 24 with a heated platen. The temperature of the platen was approximately 450°F. and it was applied at a pressure of 12 psi for approximately two minutes. The main consideration was that the polyethylene

grid 24 should be fused to a sufficient degree so that it will permeate the openings in screens 27, 29 and 30 and bond them together. It will be appreciated that any other suitable plastic, such as polypropylene, which is heat-fusible may be used. It will also be appreciated that the bonding temperatures, pressures, and times of pressing will vary with the plastic, its thickness, the types of screens being bonded, and other factors.

After the screens were bonded to each other as depicted in FIG. 8, and they formed a planar laminate 25' as shown in FIG. 8A, they were formed into the undulating shape shown in FIG. 3 by a suitable die arrangement 49 schematically shown in FIGS. 9 and 9A. The die arrangement included a lower die 50 and an upper die 51. The forming is effected by leading the edge portion 48 of the planar laminate 25' into the cavity 52 and forming an undulating shape 53 therein by bringing the upper die 51 downwardly into mating engagement with lower die 50. Thereafter, the undulating shape 53 is placed into cavity 54 and the upper die 51 is brought into forming position to form undulation 53a. The male die will thus hold the previously formed undulation 53 against movement while the straight portion of laminate 25' which overlies cavity 52 is itself formed into an undulating shape 53a. It is to be noted that there is a clearance 55 at the entry portion between dies 50 and 51, and thus the straight portion of laminate 25' can move in the direction of arrow 57 as it is initially formed into configuration 53 and thereafter the straight portion can move in the direction of arrow 57 as the laminate is formed into undulation 53a. Thereafter, undulation 53 is placed into cavity 54', and undulation 53a is placed in cavity 54, and the next undulation is formed in cavity 52. The foregoing process is repeated until all of the undulations have been formed one at a time.

It will be appreciated that if an attempt were made to form the undulations of the entire screen at the same time instead of forming each undulation sequentially,

the screen would be subjected to tearing stresses because there would not be the movement in the direction of arrow 57 as described above. However, by forming each undulation separately and sequentially while permitting the straight portion of laminate 25' to move in the direction of arrow 57 as the dies 50 and 51 are closed, tearing is obviated. The forming of undulations in the foregoing manner may be a conventional technique applied to other structures, which in this instance, is being applied to a screen laminate.

The use of the polyethylene plastic for the bonding of the screens is beneficial because the polyethylene has a certain amount of yieldability, and thus when the undulations are formed as depicted in FIGS. 9 and 9A, the polyethylene bonding will yield slightly to permit relative movement between the separate screens 27, 29 and 30 as the laminate 25' is formed into an undulating shape. This is advantageous over the use of epoxy, such as used in the past, because the very fine mesh screens, such as those over 200 mesh, could tear when they are bent into a convex shape during the forming of the corrugations when the yielding was not experienced. Furthermore, the yieldability of the polyethylene permits a certain amount of relative movement between the screens when they are subjected to high G forces in operation, thus lessening the tendency of the screen to tear and blind.

It is to be noted that plastic grids have been used in the past to bond screening screens together which were utilized in vibratory screening machines in a flat condition rather than in an undulating shape. Flat plastic bonded screens of this prior type did not function successfully in operation because the fused plastic grid permitted the screens to stretch when subjected to the high G forces encountered in operation. The reason that they stretched was that the entire width of the flat screens between their edges were unsupported. In contrast to the foregoing, the unsupported spans in the corrugated screen of the present invention is between troughs 32, and the stretching of the

fused plastic is not a factor which adversely affects the operation. In fact, it is beneficial because it provides limited amounts of yieldability, as discussed above.

Summarizing the foregoing, it is believed that the plastic grid permits the screen subassembly to be formed into an undulating shape because the fused plastic will permit the fine wires of the screening screens to yield relative to the other wires to which they are bonded when they are formed into a convex shape at the crests of the undulations, thereby obviating the tearing which could otherwise occur when unyielding epoxy was used. Furthermore, even though the fused plastic does not have the adhesive strength of epoxy, and even though the fused plastic grid does not have sufficient bonding strength to maintain flat screens securely bonded in operation, the present undulating screens will not yield excessively in operation because of the fact that the unsupported spans of screen are short, namely, from trough to trough, and the fused plastic is strong enough to maintain the required bond of the screens in such unsupported spans. In addition, the plastic grid greatly simplifies fabrication of the undulating screen.

After the undulating screen subassembly 25 has been completely formed in the manner described above relative to FIGS. 9 and 9A, it has the shape such as shown in FIG. 9B wherein the ends 25e are not flattened. The next step in fabricating the screen subassembly 25 is to flatten the ends 25e as shown in FIG. 9C. Thereafter, the ends 25e are trimmed, if necessary, as depicted by dotted lines 25t so that a proper amount of flattened portion 25f remains for bonding to plate 11. The next step in the process is to locate the screen subassembly 25 on plate 11 in the following manner, as shown in FIG. 9D. In this respect, it is required that the precise number of ridges 31 should exist in the screen and that the ridges 31 must be spaced apart a predetermined distance, such as Y. Thereafter, the flattened portions 25f and the undersides

of troughs 32 are bonded at 33 to plate 11. However, before this bonding occurs, the ridges 31 at the extreme outer ends of the screen subassembly 25 are precisely located a distance X from channels 22 and 23 of plate 11. Therefore, since the crests of each of the ridges 31 are spaced from each other the predetermined distance Y and since the crests of the outer ridges 31 are spaced from channels 22 and 23 a precise distance X, each screen assembly 10 will be exactly like every other one which is made. The significance of this is that when the plurality of screen assemblies 10 are placed end-to-end on the bed of a vibratory screening machine, the troughs of adjacent assemblies 10 will be in exact alignment with each other, as will the ridges be. This is shown in FIG. 20. Therefore, there will be a clear path lengthwise of the bed of the vibratory screening machine for material to pass from each screen assembly 10 to its adjacent screen assembly 10.

The contacting portions of the screen subassembly 25 and plate 11 are bonded to each other by epoxy, as mentioned above. This bonding is effected by dipping a heated perforated plate 11 into a fluidized powdered epoxy bed so that the powdered epoxy adheres to the plate. The plate with a layer of powdered epoxy thereon is then cooled. Thereafter, it is reheated to 350°F., and a suitable press (not shown) is used to hold the undersides of the troughs of the screen subassembly 25 in engagement with plate 11 for approximately three minutes and the epoxy will fuse into the undersides of the troughs of the screens. After the epoxy cools, the undulating screen will be bonded to the plate. The foregoing broad technique of bonding by the use of powdered epoxy is conventional in the art. If desired, the screen subassembly can be adhesively secured to plate 11 by the use of liquid epoxy which is applied to the upper surface of the plate. It will be appreciated that any other suitable method of bonding the screen subassembly to the plate may be used.

After the undulating screen subassembly 25 has been bonded to plate 11, the open ends of the ridges 31 are sealed as depicted in FIGS. 11-13. In this respect, a chilled block 60 is provided, and the edge of the screen assembly 10, such as 14, is placed in abutting relationship therewith. The block is chilled to -50°F. by passing suitable refrigerant through a coil therein (not shown). Thereafter, a syringe, such as 61, containing liquid polyethylene is inserted through various of the apertures 19 adjacent edge 14 to supply polyurethane of sufficient depth to form caps 34. The chilled plate 60 hastens solidification of caps 34. The same procedure is applied at edge 15. It will be appreciated that caps 34 permeate the screen subassembly 25 and also provide a seal with the edge portions 62 and 63 of edges 14 and 15, respectively. As an alternate, liquid epoxy can be used to produce caps 34. Also, the ends of the ridges may be blocked by any other suitable method which may include but are not limited to those shown in copending patent application Serial No. 08/062,464.

In FIGS. 14-18 alternate configurations of plastic grids are disclosed. The grid 24a of FIG. 14 is extremely similar to that of FIG. 7, the only difference being that the portions 47' are slightly thinner than portions 47 of FIG. 7 and also the crossover areas 67 are slightly smaller. In FIG. 15 the plastic grid 24b includes a border portion 69 and the grid is in the form of square openings 70. In FIG. 16 the grid 24c includes a border 71 and elongated rectangular openings 72. In FIG. 17 the grid 24d includes a border portion 73 and rectangular openings, such as 74, which are staggered relative to each other. The grid 24e of FIG. 18 includes a border portion 75 and square openings 77 which are staggered relative to each other as shown.

In FIG. 19 another embodiment of the present invention is shown. Screen 10' differs from screen 10 in that the undulating screen subassembly 25' only has a

support screen 27', which is analogous to screen 27, and a single screening screen 29', which is analogous to screen 29. The screens 27' and 29' are laminated to each other by the use of a plastic grid, such as 24, in the same manner as described above, and the laminate of screens 27' and 29', which are bonded by the fused plastic grid, is corrugated into an undulating shape in the manner described above, and thereafter bonded to an apertured plate 11 in the manner described above. In other words, the only difference between the structures of screen assemblies 10 and 10' and the methods of making thereof is that the former has a support screen and two screening screens, and the latter has a support screen and one screening screen.

A screen which has proved satisfactory in tests had the following dimensions: The plate 11 had the dimensions set forth above relative to FIGS. 1-5. The base screen 27 was 20 mesh, the intermediate screen 29 was 180 mesh and the uppermost screen 30 was 210 mesh. The undulating screen had a dimension of 1.6 inches between cycles, that is 1.6 inches between adjacent crests and 1.6 inches between the bottoms of adjacent troughs. Also, the radius at the bottoms of the troughs was 1/4 inch and the radius at the crests was 1/2 inch. The height of the ridges from plate 11 to the tops of the ridges was one inch. It will be appreciated that the curvature may be of any desired dimension which will provide the proper results.

The screen assemblies described above can be utilized for dry screening, or can be utilized for wet screening of drilling mud which is a slurry of mud and water, and it can also be utilized for other liquid suspensions, such as kaolin and water. A machine of the type which performs a wet screening operation is disclosed in U.S. Patent No. 4,882,054.

The improved screen assembly 10 of the present invention, in addition to having all of the advantages enumerated above, also has all of the advantages of the

screen assemblies disclosed in copending patent application Serial No. 08/062,464, which is incorporated herein by reference, and it will be appreciated that various alternate constructions shown in said prior copending patent application can be used with the fused screen subassembly of the present invention provided they are not inconsistent therewith.

While preferred embodiments of the present invention have been disclosed, it will be appreciated that the present invention is not limited thereto but may be otherwise embodied within the scope of the following claims.

CLAIMS

1. A method of fabricating a screening screen assembly for a vibratory screening machine comprising the steps of providing a support screen, superimposing a plastic grid onto said support screen, superimposing a fine screening screen onto said plastic grid, applying heat and pressure to said superimposed support screen and first screen and plastic grid to fuse said plastic grid and thereby form a bonded subassembly by causing said fused plastic grid to permeate said fine screen and said support screen, forming said bonded subassembly into an undulating screen configuration, providing an apertured plate, and bonding said undulating screen configuration to said apertured plate.

2. A method of fabricating a screening screen assembly as set forth in claim 1 including the step of providing a finer screening screen which is finer than said fine screen, and superimposing said finer screen over said fine screen prior to said step pf applying heat and pressure to said superimposed screens.

3. A method of fabricating a screening screen assembly for a vibratory screening machine comprising the steps of providing a support screen, superimposing a plastic grid onto said support screen, superimposing a fine screening screen onto said plastic grid, fusing said plastic grid into said superimposed support screen and fine screen to form a bonded subassembly, forming said bonded subassembly into an undulating screen configuration, providing an apertured plate, and bonding said undulating screen configuration to said apertured plate.

4. A method of fabricating a screening screen assembly as set forth in claim 3 including the step of providing a finer screening screen which is finer than said fine screen, and superimposing said finer screen over said fine screen prior to fusing said plastic grid into said superimposed support screen, fine screen, and finer screen.

5. A screening screen assembly for a vibratory screening machine comprising an apertured plate, a bonded undulating subassembly of a support screen and a fine screening screen bonded to each other by a fused plastic grid, and means bonding said bonded undulating subassembly to said apertured plate.

6. A screening screen assembly for a vibratory screening machine as set forth in claim 5 wherein said bonded undulating subassembly includes a finer screening screen overlying said fine screening screen.

AMENDED CLAIMS

[received by the International Bureau on 28 June 1994 (28.06.94); original claim 5 amended; new claims 7-16 added; remaining claims unchanged (2 pages)]

4. A method of fabricating a screening screen assembly as set forth in claim 3 including the step of providing a finer screening screen which is finer than said fine screen, and superimposing said finer screen over said fine screen prior to fusing said plastic grid into said superimposed support screen, fine screen, and finer screen.

5. A screening screen assembly for a vibratory screening machine comprising an apertured plate, a bonded undulating subassembly of a support screen and a fine screening screen bonded to each other by fused plastic portions with unobstructed portions of said screens therebetween, and means bonding said bonded undulating subassembly to said apertured plate.

6. A screening screen assembly for a vibratory screening machine as set forth in claim 5 wherein said bonded undulating subassembly includes a finer screening screen overlying said fine screening screen.

7. A screening screen assembly for a vibratory screening machine as set forth in claim 6 wherein said fused plastic portions comprise a grid.

8. A screening screen assembly for a vibratory screening machine as set forth in claim 5 wherein said fused plastic portions comprise a grid.

9. A screening screen assembly for a vibratory screening machine as set forth in claim 5 wherein said apertured plate has ends, and securing means at said ends for securing said plate to a vibratory screening machine.

10. A screening screen assembly for a vibratory screening machine as set forth in claim 9 wherein said securing means comprise channel-shaped members.

11. A screening screen assembly for a vibratory screening machine as set forth in claim 9 wherein said undulating subassembly includes ridges and troughs, end portions on said ridges, and means blocking said end portions of said ridges against entry of material which is being screened.

12. A screening screen assembly for a vibratory screening machine as set forth in claim 5 wherein said undulating subassembly includes ridges and troughs, end portions on said ridges, and means blocking said end portions of said ridges against entry of material which is being screened.

13. A screening screen assembly for a vibratory screening machine as set forth in claim 12 wherein said fused plastic portions comprise a grid.

14. A screening screen assembly for a vibratory screening machine as set forth in claim 13 wherein said apertured plate has ends, and securing means at said ends for securing said plate to a vibratory screening machine.

15. A screening screen assembly for a vibratory screening machine as set forth in claim 5 wherein said bonded undulating subassembly has a support screen side and a fine screening screen side, and wherein said support screen side is bonded to said apertured plate.

16. A screening screen assembly for a vibratory screening machine as set forth in claim 15 wherein said fused plastic portions comprise a grid.

Fig.1.

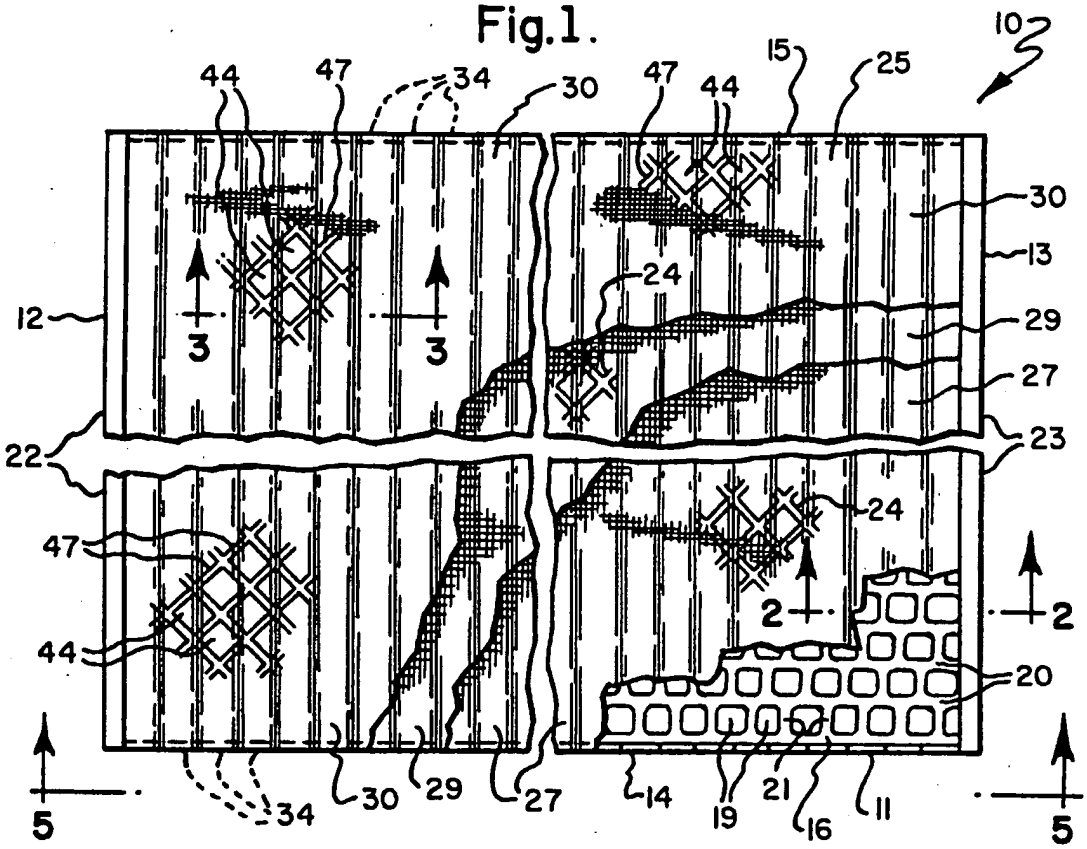
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Fig. 2.

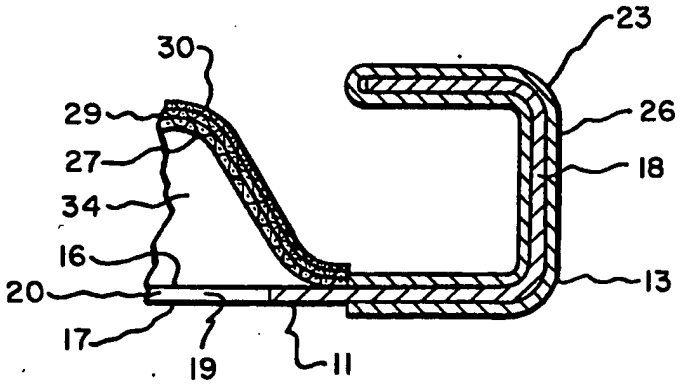
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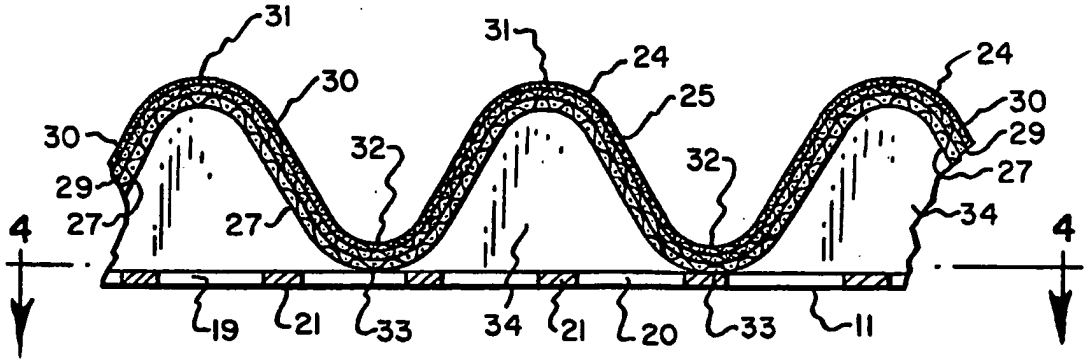
Fig. 3.



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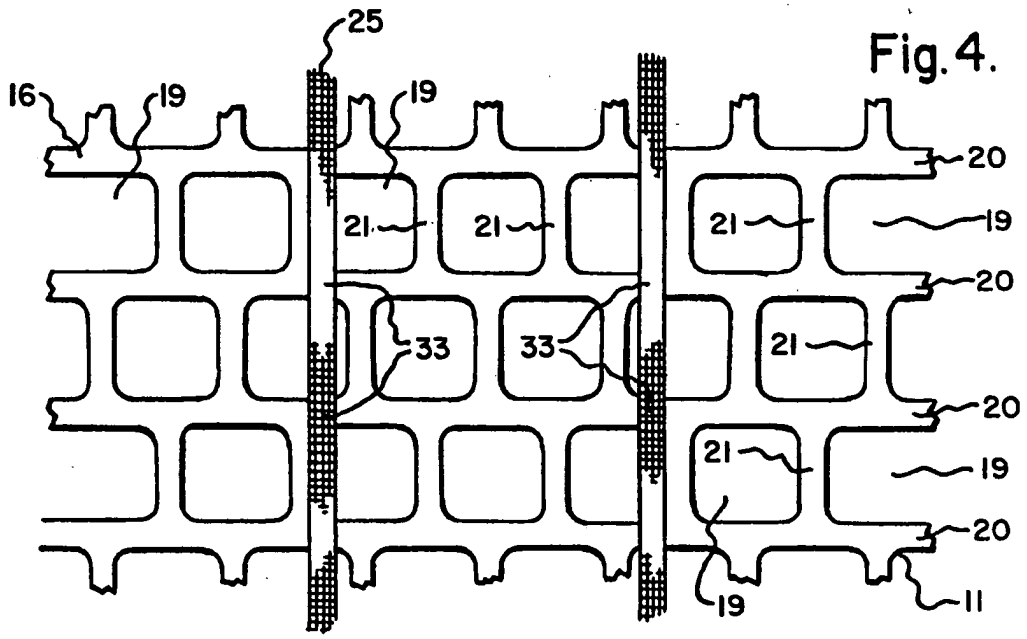

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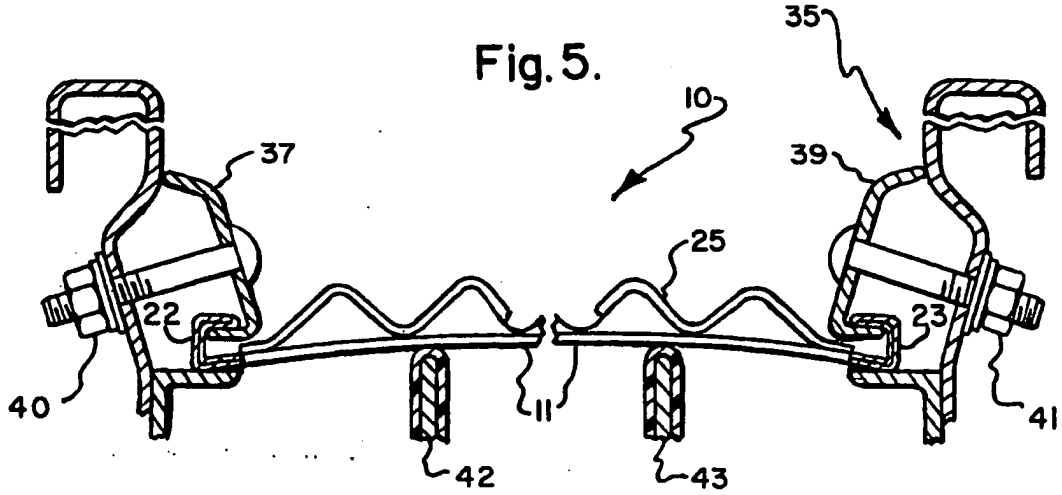

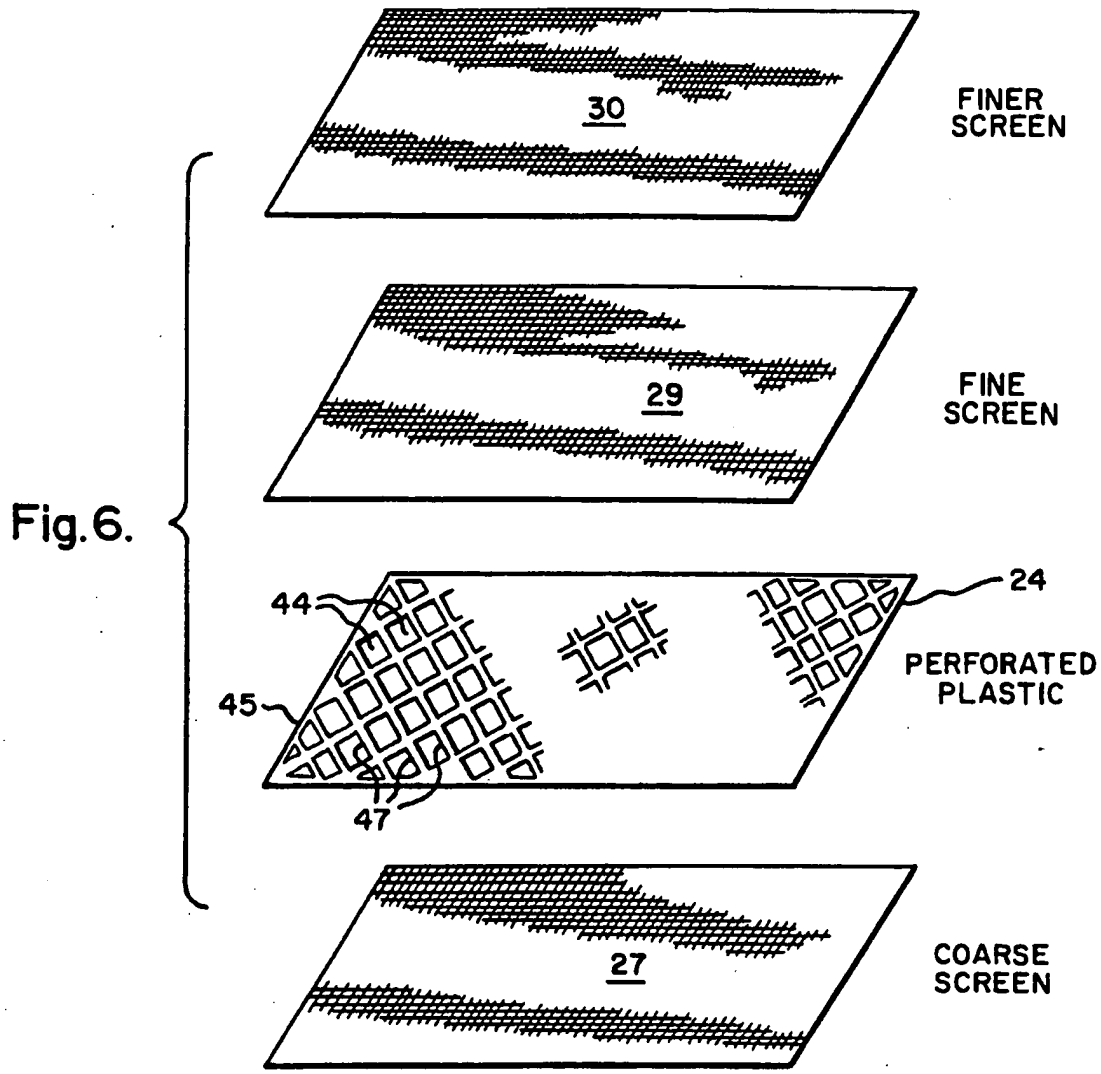
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FINE SCREEN
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27
COARSE SCREEN

Fig.6.

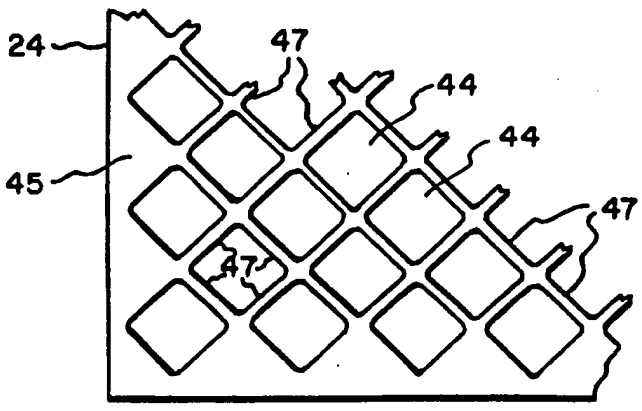
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Fig.7.

Fig. 8.

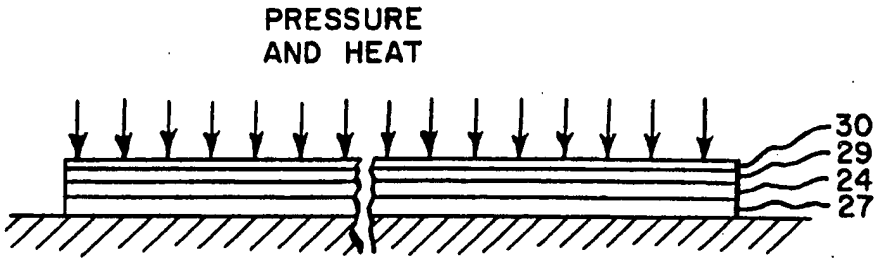


Fig. 8A.

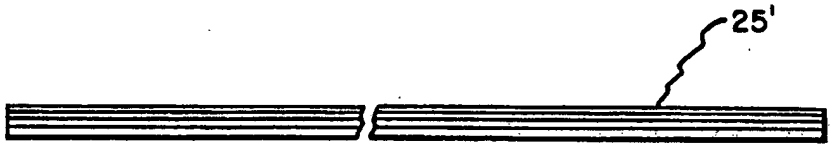


Fig. 10.

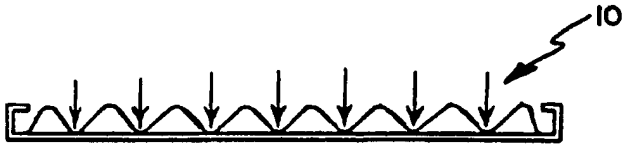
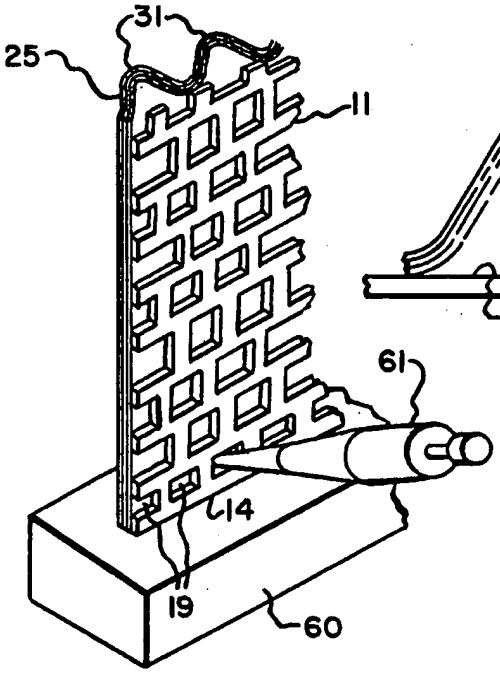


Fig. 11.



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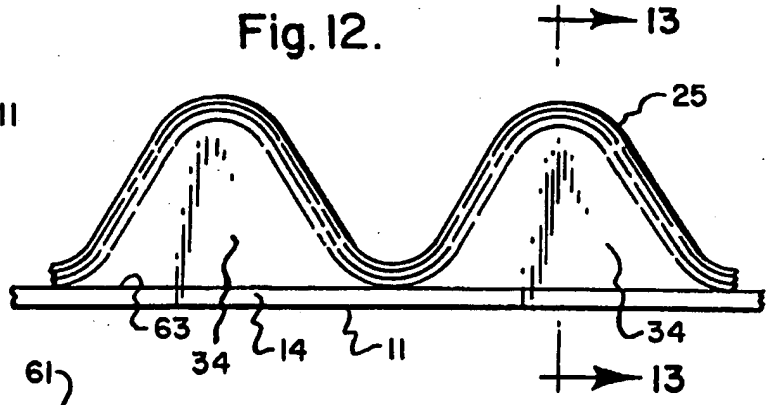

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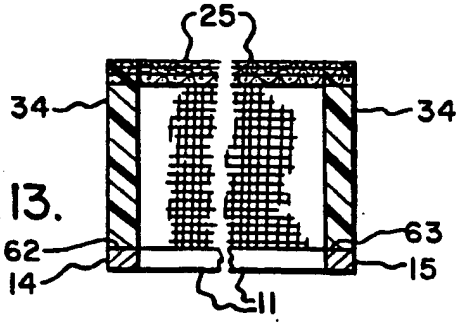

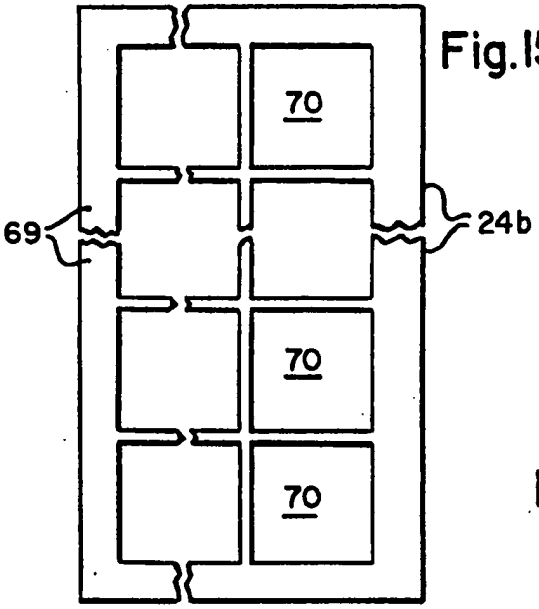

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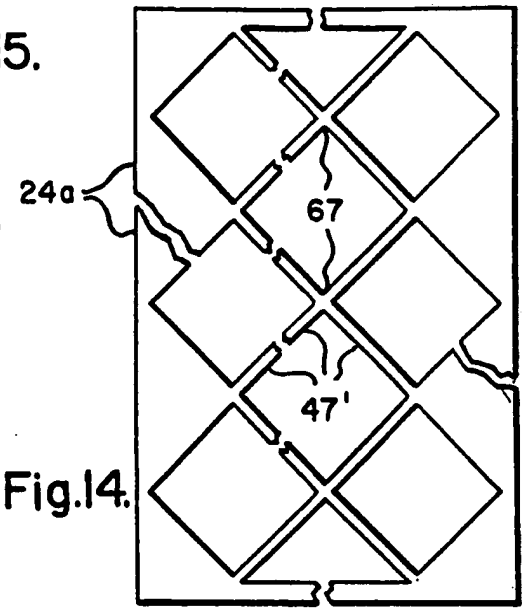

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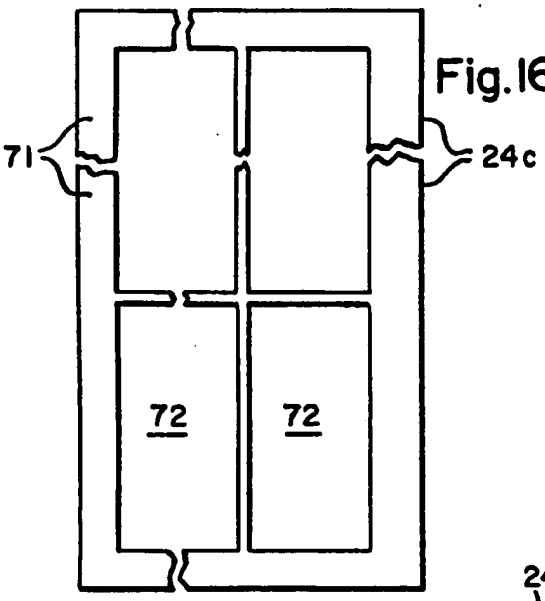

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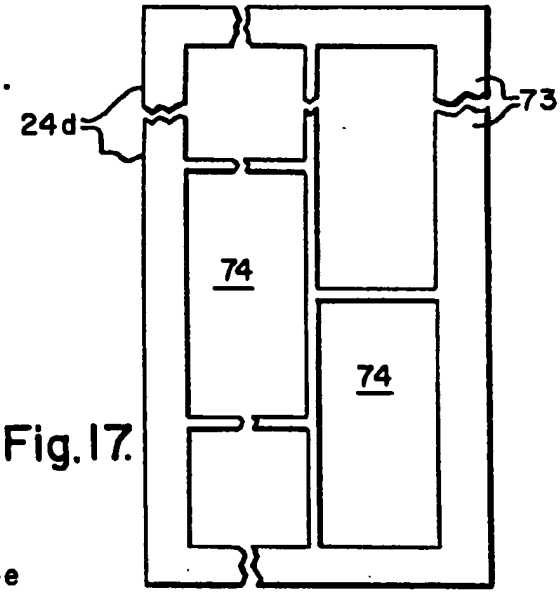


Fig.17.

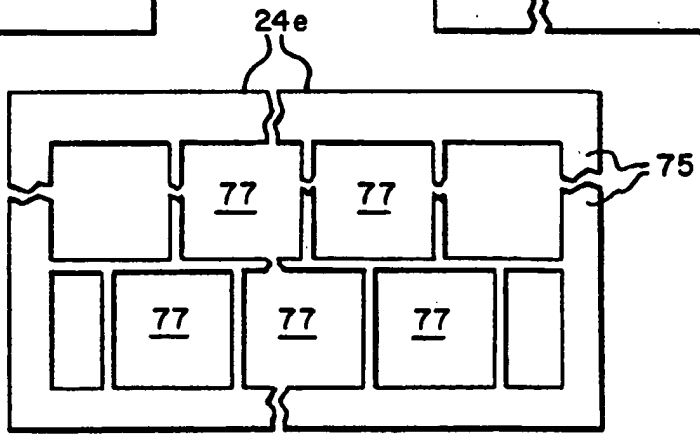
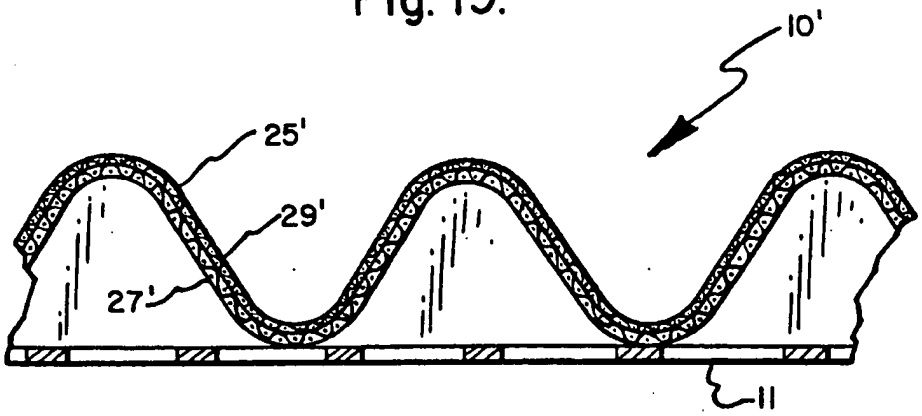


Fig.18.

Fig. 19.



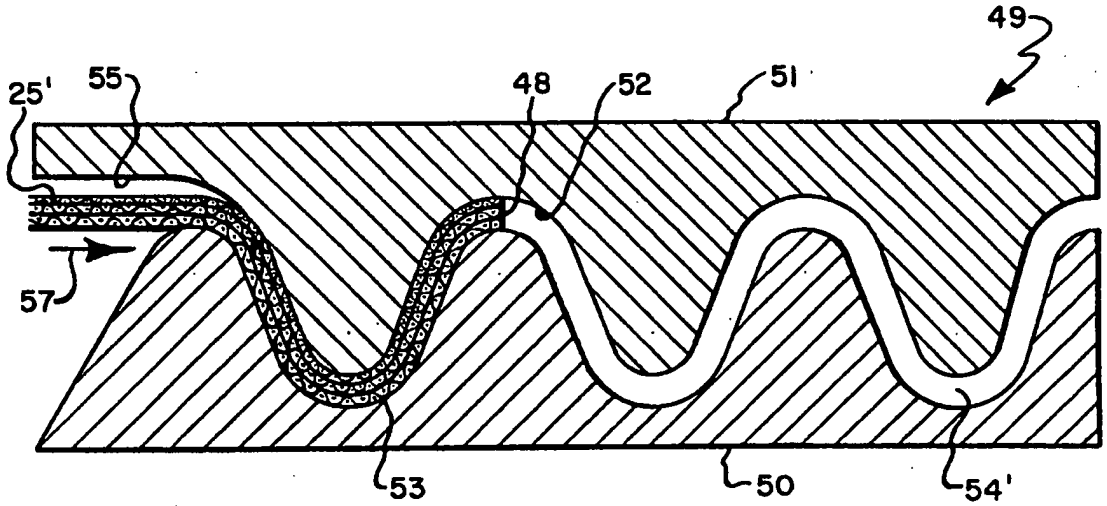


Fig. 9.

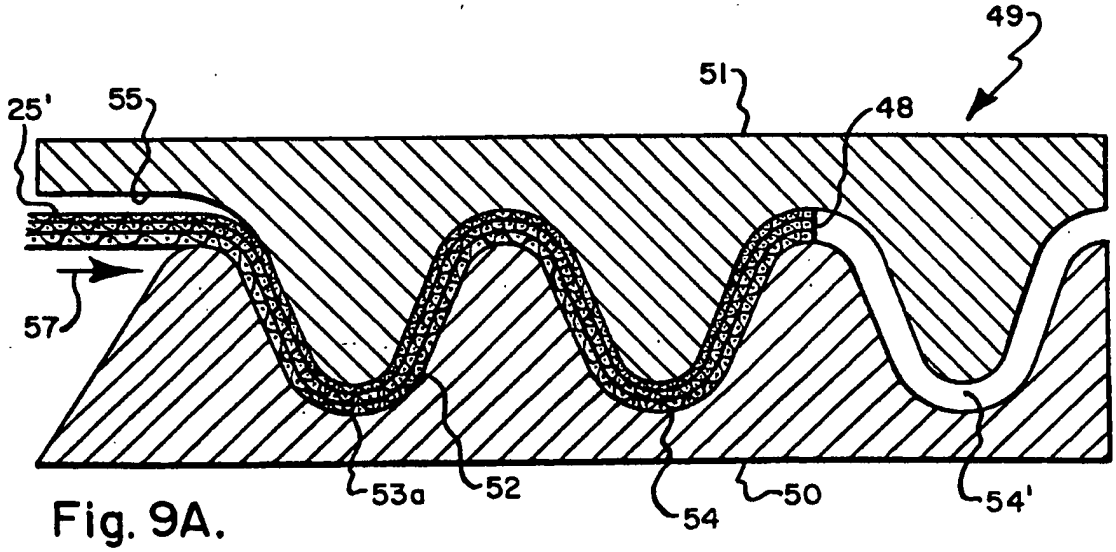


Fig. 9A.

Fig. 9B.

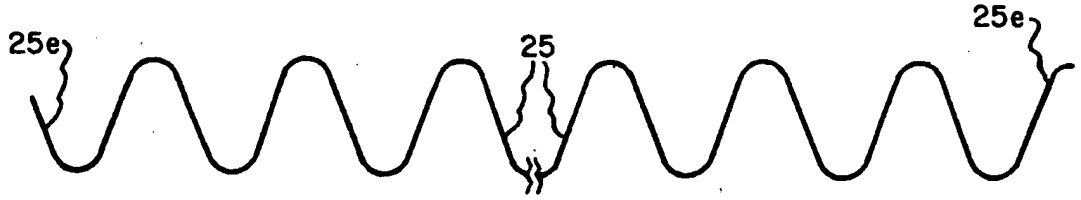


Fig. 9C.

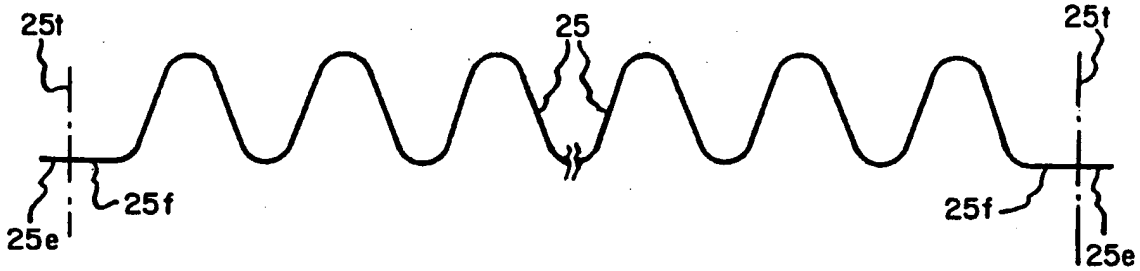
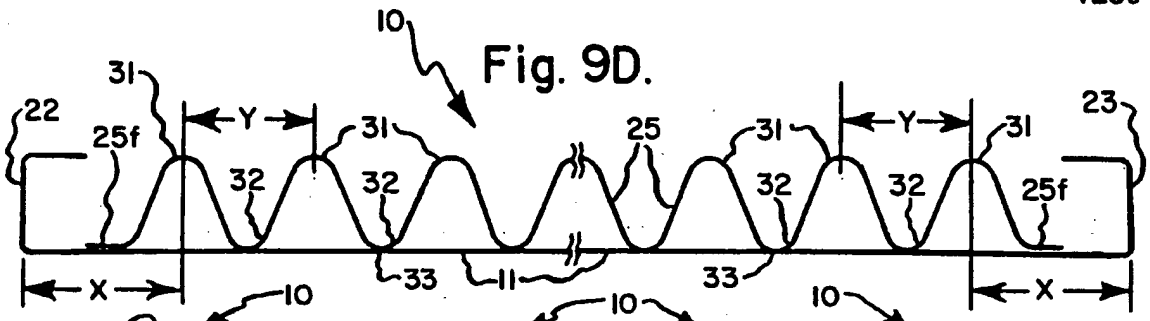


Fig. 9D.



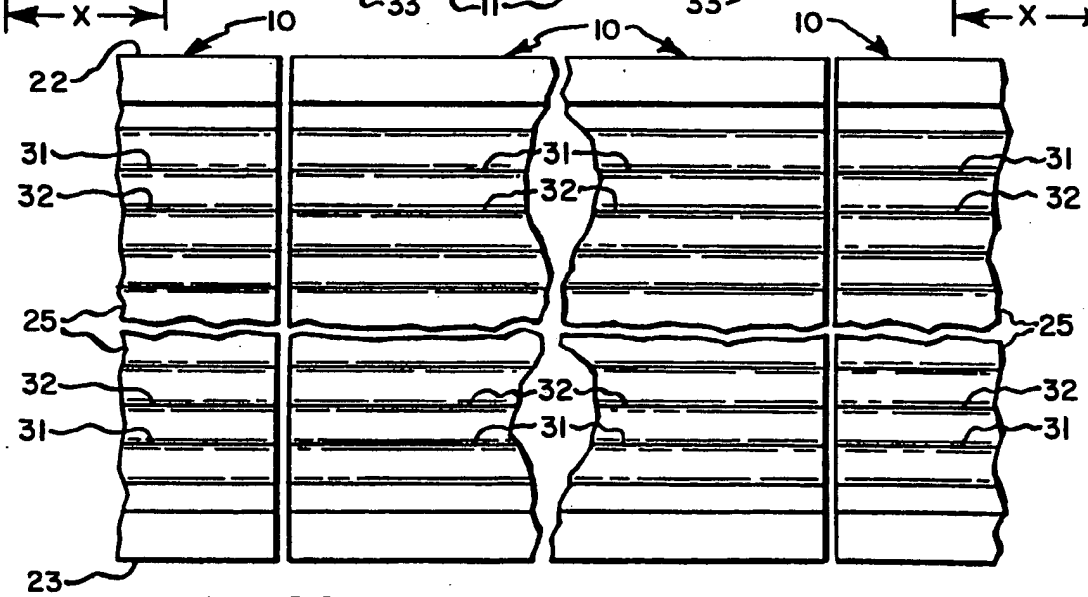


Fig. 20.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US94/00242

A. CLASSIFICATION OF SUBJECT MATTER
IPC(5) :BO7B 1/28,1/46;B23P 15/00,15/16
US CL :Please See Extra Sheet.
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : Please See Extra Sheet.

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

NONE

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

NONE

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US, A, (DERRICK ET AL) 11 MARCH 1986, SEE FIG. 1.	1-6
Y	US, A, 3,255,885 (BURLS) 14 JUNE 1966. SEE FIG. 3 AND COL. 3 LINES 5-40.	1-6
Y	US, A, 4,075,106 (YAMAZAKI) 21 FEBRUARY 1978, SEE FIG. 1.	1-6
Y	GB, A, 823,648 (AIR-MAZE CORPORATION) 18 NOVEMBER 1959, SEE FIG. 1-2.	1-6

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be part of particular relevance

"E" earlier document published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

21 APRIL 1994

Date of mailing of the international search report

03 MAY 1994

Name and mailing address of the ISA/US
Commissioner of Patents and Trademarks
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Washington, D.C. 20231

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Authorized officer

THOMAS M. LITHGOW

Telephone No. (703) 308-0173

Form PCT/ISA/210 (second sheet)(July 1992)*

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US94/00242

A. CLASSIFICATION OF SUBJECT MATTER:
US.CL :

210/388,493.3,493.5,492,483,484; 209/397,399,401,403,329,330; 29/163.6,163.8,902;
156/308.2,308.4,309.6,290,210,208; 264/286,324,325,339

B. FIELDS SEARCHED
Minimum documentation searched
Classification System: U.S.

210/388,493.3,493.5,492,483,484; 209/397,399,401,403,329,330; 29/163.6,163.8,902;
156/308.2,308.4,309.6,290,210,208; 264/286,324,325,339